the gates are raised the water pours from these penstocks into the wheels that give motion and life to the big generators. As the water passes through, or is discharged from, the turbines, it falls into the tunnel, and then flows through this tail race to the lower river and gorge. It is diverted from the main stream but a very few minutes, but in that time it serves to aid man in gaining control of thousands of electrical horse-power.

It is agreed between the power companies and the commissioners of Victoria Park that all power generated in the park limits must be transmitted outside the park boundaries for application and use, and so the electric current from the station referred to will pass to a transformer station not far distant, where, for transmission purposes, it will have its voltage raised to 40,000 or 60,000 volts, in order that it may successfully and economically be sent to Toronto and other distant places to meet the demand for electric power from Niagara. Toronto has long been anxious to be connected by a transmission line with the power development at the falls, and now a line for transmission purposes has been about completed, so that electric current from the generators in the station of the Canadian Niagara Power Company may be used in the operation of the trolley cars and lighting systems of the Canadian city nearly 90 miles away from Niagara.

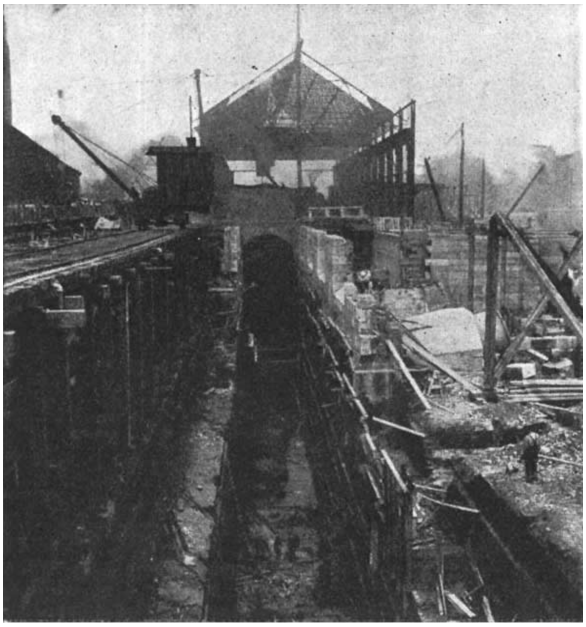

**Fig. 2.**—Power House of Canadian Niagara Power Co., being erected over the wheel-pit.

The Electrical Development Company of Ontario, Ltd., is also constructing a wheel-pit and tunnel power development in Victoria Park. The works of this company will be a short distance above the site of the development of the Canadian Niagara Power Company, but, for all this, the tunnel it is building will be slightly shorter than the tunnel of the company last named, because it will run right under the river-bed, over which the upper rapids toss, to a point behind the falling sheet of water of the Horseshoe Fall, where it will empty into the lower river. From the bottom of this wheel-pit there will be two short lateral tunnels that will carry the water from the pit to the main tunnel at a point 165 feet from the bottom of the slot. This company projects a development of about 125,000 horse-power, and the machinery it will instal will command general attention.

The Ontario Power Company is another concern that has secured a franchise for the development of power in Victoria Park. Its method of development will be quite different from that of the other two companies referred to. Its power house, a concrete and iron structure, has been built at the water's edge, in the gorge, a short distance below the Horseshoe Fall, and water will be carried to it by penstocks concealed from view in tunnels that have been driven through the rocky bank from a spillway or open relief on top of the bank. From this spillway great steel flumes will extend to the forebays, which are situated far up the river. There will be three of these steel flumes, each 18 feet in diameter and more than 6000 feet long. Each will divert 3900 cubic feet of water every second, which is an amount estimated to be sufficient to develop 60,000 electrical horse-power in the station at the water's edge. Thus from the three steel flumes and the water supply thus afforded, no less than 180,000 horse-power is to be developed. This power will pass from the generators to a transformer station located on the bluff in the rear of Victoria Park more than 250 feet above the power house, and more than 550 feet back from it.

ORRIN. E. DUNLAP.

## INVESTIGATION OF THE UPPER AIR.

THE subjoined announcement has been received from the director of the Meteorological Office.

In response to representations from various quarters, the Meteorological Committee has assigned from the Parliamentary grant under its control a sum for promoting the investigation of the upper air by kites and other means.

The immediate objects in view are:—(1) To establish an experimental station where kite ascents and other experimental investigations can be carried out, especially on the days selected for international cooperation. (2) To develop and extend the instrumental equipment, so that facilities may be afforded for the cooperation of other observers upon sea or land. (3) To provide for the publication of the observations in combination with those of other countries, by a contribution to the cost of the international publication undertaken by the president of the International Commission for Scientific Aërostation, Prof. H. Hergesell, of Strassburg.

Mr. W. H. Dines, F.R.S., has undertaken the direction of the operations for the Meteorological Office. His experiments for the office are carried on at his house at Oxshott.

An endeavour will be made, with fair prospect of success, to enlist the cooperation of marine observers in correspondence with the office. Captain A. Simpson, of the S.S. *Moravian*, has already expressed his willingness to make a trial of this method of extending our knowledge of marine meteorology as soon as the necessary gear and instruments can be supplied.

It is hoped that through the assistance of others who are interested in such investigations, and have at their disposal the means of carrying them out, an effective scheme for the investigation of the upper air may be set on foot. Lieut.-Colonel J. E. Capper, C.B., R.E., of the Aldershot Balloon Companies, has already facilities for such purposes, and will take part; Mr. G. C. Simpson, lecturer in meteorology in the University of Manchester, is making arrangements for occasional observations on the Derbyshire hills; Mr. C. J. P. Cave, who has already made some interesting kite ascents in Barbados, has provided himself with the necessary equipment for experiments at Ditcham Park; and Mr. S. H. R. Salmon has arranged a station on the Downs near Brighton, and carries out ascents on the international days.

There is, accordingly, a prospect of an effective investigation being commenced.

## BOTANY AT THE BRITISH ASSOCIATION.

THE president, Mr. Harold Wager, F.R.S., dealt in his address, which was delivered at Johannesburg, with some problems of cell structure and physiology. The text of this address has already appeared (September 21) in NATURE.

As was to be expected, there were fewer papers than usual this year in Section K, and of these relatively few were of a purely technical nature, the majority being either general accounts of recent work or else papers which possessed some special local interest.

*General Papers.*—Prof. R. W. Phillips opened the proceedings at Cape Town by delivering a semi-popular lecture on recent advances in our knowledge of seaweeds. Dealing first with the attached shore vegetation, the lecturer pointed out that, with the exception of a very few phanerogams, this consists entirely of blue-green, green, red, and brown algæ. In the red algæ the most important recent work is that of Oltmanns, who has shown, in opposition to the view maintained by Schmitz, that no real nuclear fusion takes place in the auxiliary cells. In the brown algæ Williams's work on the Dictyotaceæ has considerably modified the views previously held regarding them. Not only has he discovered motile antherozoids in this group, but his work on their cytology points to the existence of a definite alternation of generations. Farmer and Williams had shown that in the Fucaceæ the reduction of chromosomes takes place at the origin of the oogonium. In Dictyota, however, as originally shown by Mottier, and since confirmed by Williams, the reduction division occurs in the mother-cells of the tetraspores. There would thus appear to be in this plant two generations, precisely similar in their external morphology, but fundamentally distinct in respect of the number of chromosomes in the dividing nucleus. Our knowledge of the floating oceanic vegetation has been greatly extended by the members of the German plankton expedition, and other workers. The lecturer dealt with the distribution of this floating vegetation in the surface waters of the globe, and described some of the adaptations which prevent rapid sinking of the minute forms composing it.

Mr. R. P. Gregory discussed some of the problems of heredity. He first gave a general account of Mendel's principles of heredity, referring to some of the more recent work on Mendelian lines. He then dealt particularly with some new experiments conducted by Mr. Bateson and himself, on the inheritance of heterostyly in Primula. Although certain irregularities were observed, on the whole the characters of long and short style were inherited in the usual Mendelian ratio, the short style being dominant, the long recessive. Further experiments, conducted in the hope of throwing light on the fact, observed by Darwin, of the relative infertility in "illegitimate" as compared with "legitimate" crosses in Primula, were inconclusive.

Prof. F. E. Weiss contributed a paper on the value of botanical photographs. He pointed out that the mapping of the plant-associations of any given district, and the detailed study of the ecological factors concerned, can be most usefully supplemented by good photographs showing the general aspect and distribution of the vegetation. It is important to have, not only general photographs of various plant-associations, but also photographs of the different members of such associations. Plant photography can also be usefully employed in morphological, pathological, and other studies. The truth of the author's remarks was forcibly illustrated by a series of beautiful lantern slides. Two committees are now at work collecting botanical photographs and rendering them available for teaching and other purposes. One, recently established for the survey of British vegetation, is concerning itself with British ecological photographs; the other, the British Association committee for the registration of photographs of botanical interest, has adopted a wider scheme, and is anxious to receive help from scientific photographers in all parts of the world.

An interesting discussion took place on educational methods in the teaching of botany. The president (Mr. Harold Wager, F.R.S.), who opened the discussion, was of opinion that the methods usually employed, both in universities and schools, neither develop real interest in the subject nor afford an adequate training in scientific method. He emphasised the importance of basing all courses of botanical teaching on practical work, both observational and experimental, such work to be carried out by the students themselves. Lectures should be rather of the nature of discussions upon the facts learned during practical work than merely informational. A good deal of faulty educational method is due to the domination of examinations. It is almost impossible for satisfactory work to be done if teachers are compelled to follow set syllabuses, which are generally so extensive as to leave little room for originality on the part of the teacher.

Several speakers agreed with the general conclusions of the president, but Mr. A. C. Seward, F.R.S., and Prof. Douglas Campbell were inclined to lay more stress on the importance of lectures, particularly where advanced students are concerned.

Miss Lilian Clarke contributed to the discussion a most interesting account of her methods of teaching botany in the James Allen School for Girls at Dulwich. She gives no set lectures, but the girls make observations and conduct experiments, not only in the school garden, where each girl has charge of a plot, but also in the laboratory. The latter has been designed so as to admit as much light as possible; it can also be kept at a constant temperature, so that practical work on living plants can be carried on at all seasons of the year.

*South African Botany.*—Mr. A. C. Seward, F.R.S., in discussing the fossil floras of South Africa, gave a general account of the plants characteristic of the Lower Karroo, Stormberg, and Uitenhage series. He laid stress on the need for further field work, as more material, particularly petrified specimens for microscopical examination, is badly needed to render our knowledge of these floras more complete.

Prof. A. Engler and Dr. R. Marloth presented important papers on the floras of tropical Africa and South Africa respectively.

Prof. Engler dealt with his subject largely from the ecological point of view. Discussing first the meteorological conditions of tropical Africa, he pointed out that in every tropical country, where the altitude of the land surface varies from sea-level to high mountains, practically the same plant-formations can be distinguished, though, of course, their systematic composition may be very different in different cases. The author then enumerated the various halophilous, hygrophilous, xerophilous and other formations, with their subdivisions, finally discussing the affinities of the flora as a whole. The dominant element of the flora is one peculiar to tropical Africa, the plants composing which are more nearly related to those of India and Madagascar than they are to those of tropical America. But besides this native element, we find in tropical Africa other elements. Thus in the hygrophilous formations of East Africa, Indian and Madagascan elements abound, while in those of West Africa a distinct tropical American element is found. A South African element is present, particularly in the shrub-formations of Angola and East Africa; a Mediterranean element in the north-east, especially in Somaliland; and lastly, in the high mountains, many species belonging to a boreal element are found. From the entire absence on these mountains of many groups characteristic of northern regions, Prof. Engler concludes that such northern forms as are here found have entered by immigration, and are not the remnants of a once widely spread Old World flora.

The botanical regions proposed by Dr. Marloth in his paper on the phyto-geographical subdivisions of South Africa are somewhat similar to those suggested by Bolus, Engler, and others, though differing in detail. The two main divisions, very unequal in size, are A, the Cape province, characterised by many endemic plants of more or less south temperate affinities, and B, the palæo-tropical province. The latter is again subdivided, according to ecological conditions and floral constituents, into (1) the grass-steppe regions, including the Bush-veld, High-veld, Kalahari, and the Caffrarian countries; (2) the central districts of Cape Colony, including the Karroo, the Karroid plateau and Little Namaqualand; (3) the western littoral; (4) the forests of the south coast; (5) the south-eastern coast belt.

Mr. J. Burtt-Davy contributed a paper on the climate and life zones of the Transvaal. He divides the Transvaal, according to altitude and climate, into three zones, which he terms the High, Middle, and Low Veld respectively. Each is characterised, not only by its native vegetation, but also by the crops it is capable of producing.

Mr. F. B. Parkinson gave an interesting account of irrigation farming as carried on at the Orange River farm at Baviaankrantz. To raise the water, chain and bucket pumps are employed, working in shafts sunk at a sufficient distance from the river to be above flood-level. The shafts are supplied with water from the river by means of 10-inch syphons. By judicious watering, winter cereal crops, and summer crops of potatoes, peas, &c., can be profitably grown.

Mr. T. R. Sim discussed the distribution of South African ferns, and pointed out that the recent opening up of the Orange River Colony, the Transvaal, and Rhodesia has resulted in the filling up of many gaps in our knowledge of this subject.

Dr. Schönland gave a survey of our knowledge of South African succulent plants, chiefly from the historical and systematic points of view.

A paper was also contributed by Mr. J. Medley Wood on the indigenous plants of Natal.

*Technical Papers.*—Among these may be mentioned an interesting note by Dr. Horace T. Brown, F.R.S., on the dissipation of absorbed solar radiation by xerophilous plants. He pointed out that in ordinary foliage leaves the amount of heat necessary to vaporise the water of transpiration is so considerable that such a leaf may be subjected to intense solar radiation without acquiring a temperature of more than a very few degrees above that of the surrounding air. In xerophilous plants, however, transpiration is at a minimum, and therefore some other method of guarding against the risk of dangerously high temperatures is necessary. According to the author, this is to be found in the loss of heat due to thermal emission. Experiments have been conducted by him (in collaboration with Dr. W. E. Wilson) which show that a powerful cooling effect is produced by the high thermal emissivity of a leaf surface, even when transpiration is completely in abeyance.

Prof. H. H. W. Pearson communicated an interesting account of his investigations into the development and germination of the spores of Welwitschia. The results obtained show that some of the current views of the relationship of this extraordinary plant to the other genera of the Gnetaceæ must be considerably modified.

Prof. Douglas Campbell described the prothallium and reproductive organs of *Gleichenia pectinata,* and directed attention to the similarity that exists between them and those of Osmunda.

Prof. M. C. Potter presented two papers. In the first an account was given of some experiments which showed that amorphous carbon can be slowly decomposed by the agency of a soil bacterium, with the evolution of carbon dioxide.

The second dealt with the healing of parenchymatous tissues in plants. According to the author, the first step in this process (prior to the formation of cork) is the closing of the intercellular spaces by the formation of a "wound-gum" similar to that described by Temme in wounded xylem vessels. Thus the increased rate of gaseous interchange caused by the wound is very soon checked.

Mr. I. B. P. Evans, in a paper on infection phenomena in the Uredineæ, said that it is quite possible to identify different species of Puccinia by the shape of their infection vesicles.

Dr. G. Potts contributed a paper on the action of calcium compounds on *Plasmodiophora Brassicae* ("finger and toe"). Experiments show that an acid soil encourages the growth of the parasite, while alkaline substances inhibit it.

A most interesting feature of the Cape Town meeting was afforded by a fine collection of native plants, brought together with considerable trouble by Dr. Marloth. These included a number of the more striking succulents from the Karroo region, and also a great many plants from the south-west district of Cape Colony. The latter were, for the most part, in flower, the heaths and the Iridaceæ in particular presenting a beautiful blaze of colour. Dr. Marloth also exhibited a number of ecological photographs taken in various parts of Cape Colony.

But, apart from the meetings themselves, the over-sea botanists found considerable opportunities of observing the vegetation of the various districts passed through during the tour. It is true that much of the travelling was hurried, but even when passing rapidly through a new country a botanist is able to gather valuable impressions of the general facies, &c., of the vegetation.

At the Cape, though the season was still early spring, a considerable number of plants were in flower. Table Mountain and the slopes of the Lion's Head were explored so far as time permitted, and many plants characteristic of the Cape Peninsula flora were observed. Some of the most striking of these were plants belonging to the families Ericaceæ, Proteaceæ, and Restiaceæ.

Several members of Section K visited the Karroo, and spent some days in examining the many curious xerophilous desert plants to be found there.

In the Transvaal and elsewhere little or no rain had fallen for some five months before the visit of the association, and in consequence the country presented a very parched and brown appearance, except where irrigation had resulted in vivid patches of green crops, or groves of Eucalyptus trees had been planted. The latter, as well as other Australian plants, have been extensively imported, and promise to become of considerable economic importance in South Africa.

A very striking feature of the bush vegetation in various parts of the Transvaal was the extraordinary prevalence of parasitic Loranthaceæ, many of the acacia and other trees being loaded with the parasites.

At Pretoria the Government experimental grounds were visited, the visitors being received by Mr. Smith, the Director of Agriculture, and Mr. Burtt-Davy. Extensive experiments are being at present carried on here with a view to the introduction of new grasses to improve the pasturage of the Transvaal. Other useful introduced plants include several species of Atriplex (the Australian "saltbush"). As these plants are markedly xerophilous, and at the same time good fodder plants, they will probably prove very useful in a climate such as that of the Transvaal.

The agricultural department in Pretoria had also arranged an exhibition illustrative of the vegetable products of the Transvaal.

Mr. Burtt-Davy arranged a special botanical excursion to the Magaliesberg, where the "Wonderboom," an exceedingly fine specimen of *Ficus cordata,* was visited.

Other areas of botanical interest passed through included the High Veld, the Bush Veld, the teak forest of Rhodesia, and the luxuriant so-called rain-forest immediately surrounding the Victoria Falls.

## *PRIZE SUBJECTS OF THE INDUSTRIAL SOCIETY OF MULHOUSE.*

THE Industrial Society of Mulhouse has issued its programme of the prizes to be awarded by the society during the year 1906; excluding the subjects which are of a purely local or technical character, the following are the principal prizes open to competition to all nations.

In the section of chemistry medals of honour are offered for a memoir on the theory and manufacture of alizarin-red by the rapid process, for a synthesis of the colouring matter of cochineal, for a research on cochineal carmine, for an investigation of the colouring matter of cotton, of the transformation of cotton into oxycellulose, or of the composition of aniline blacks; also for a research on the chemical changes of wool under the action of hypochlorites or chlorine, for a synthesis of a natural dye, for a theory of the manner of formation in nature of any organic substance, or for a chemical study of the fat of Turkey-red. Several medals will also be awarded for special chemical studies of mordants and their action, for the production by artificial means of certain dyes, and for practical methods of fixing certain dyes to the fibre. A method of manufacturing carbon tetrachloride at a price such as will enable it to compete with carbon bisulphide and benzene is also required. A sum of 500 francs to 1000 francs will be allotted to the best compilation of the densities of inorganic and organic substances in the solid state and in cold saturated solution. Medals will be given for the production of substances capable of taking the place of certain named chemicals which have an industrial use, and for the solution of a number of specified problems in the bleaching, dyeing, and printing of textiles.

In the section of mechanical arts a prize of 500 francs with a silver medal is offered for a new method of construction of buildings suitable for cotton spinning, wool combing, or calico printing. The following subjects will receive medals:—a new type of steam boiler; an indicator of the total work done in a steam engine; new forms of